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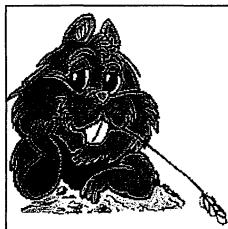
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Punxsutawney's Phenomenal Phorecaster

*Michael A. Aaron, Brewster B. Boyd, Jr., Melanie J. Curtis,
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Paul Sommers (psommers@panther.middlebury.edu) is a Professor of Economics at Middlebury College. Camera-shy co-authors saw their shadows and disappeared after graduating from Middlebury College in 2000. Michael, Melanie, and Brewster majored in Economics. (Brewster doubled with Environmental Studies.) All three are probably on assignment somewhere with the "Weather Channel" or just waiting to emerge from their underground home.

"If Candlemas Day [Feb. 2] is bright and clear,
there'll be twa [two] winters in the year."

—Anonymous

"Friends," he said, "I've got a hunch. When I come out of my burrow on Groundhog Day, I don't think I'll see my shadow."

"Hooray!" shouted Sherwood Squirrel.

"That means we'll have an early spring!" said Penelope Porcupine.

"Six weeks less of winter!" said Reginald Rabbit.

—Steven Kroll,

It's Groundhog Day! [2]

"Punxsutawney Phil," the national groundhog in Punxsutawney, Pennsylvania, is the granddaddy of weather-forecasting groundhogs. According to legend more than a century old, if Phil doesn't see his shadow on Groundhog Day (February 2nd), the midpoint of winter, spring is just around the corner. But, if he does, everyone faces six more weeks of winter. Members of Punxsutawney's "Inner Circle," the local group that claims to communicate with Phil, say that he is always right. (His predictions are even kept in the *Congressional Record*.) But can the revered weather prognosticator's forecasts stand the test of time?

The purpose of this note is to assess the accuracy of Phil's prognostications over the 50-year period from 1950 through 1999. The closest observer to Punxsutawney, Pennsylvania with comprehensive data on daily minimum temperature (degrees Fahrenheit), maximum temperature, and snowfall (inches) is Putneyville (14.7 miles from Punxsutawney). These data were obtained from the Northeast Regional Climate Center at Cornell University in Ithaca, New York (e-mail: nrcc@comell.edu). Groundhog Day predictions indicating whether or not Phil saw his shadow are from www.groundhog.org/history/predictions.shtml.

To measure the accuracy of Punxsutawney Phil's forecasts, we suggest that an early spring might be indicated by

1. the minimum average daily temperature during the six weeks following February 2 being "significantly" higher than during the six weeks preceding February 2,
2. the maximum average daily temperature during the six weeks following February 2 being "significantly" higher than during the six weeks preceding February 2,

3. the average daily snowfall during the six weeks following February 2 being “significantly” lower than during the six weeks preceding February 2.

For each of the three criteria (1), (2), and (3) above, we will test for temporal effects such as shifts in temperature or snowfall amounts following February 2. This will be done by means of regressions of the form $\text{TEMP} = a + Z_1\text{TIME} + Z_2\text{PHIL}$, where TEMP is the minimum (or maximum) daily temperature six weeks before February 2, Groundhog Day, and six weeks thereafter; TIME is the time trend; and PHIL is a dummy variable which is equal to 1 during the six weeks following February 2 and 0 otherwise.

Table 1 shows the results of 146 regressions. (The level of significance was $a = .05$.) If, for example, Phil does not see his shadow (a harbinger of an early spring) and he is correct, then the estimated coefficient b_2 will be positive and statistically discernible from zero. When the dependent variable is snowfall, Phil does not see his shadow and he is correct, b_2 will be negative and significant. If, however, Phil sees his shadow and he is correct, then b_2 will not be discernible from zero. Or, if b_2 is statistically discernible, the sign is opposite what one would expect from an early spring.

Table 1. Punxsutawney Phil’s Prediction Record, 1950-1999

Groundhog Day,		Did Phil See His Shadow?	Was Phil Correct?		
Year			Minimum Temperature	Maximum Temperature	Snowfall
1950		NO	NO	NO	NO
1951		YES	YES	YES	*1
1952		YES	YES	YES	YES
1953		YES	YES	YES	YES
1954		YES	YES	YES	YES
1955		YES	YES	YES	YES
1956		YES	NO	YES	YES
1957		YES	NO	YES	YES
1958		YES	YES	YES	YES
1959		YES	YES	YES	YES
1960		YES	YES	YES	YES
1961		YES	YES	YES	YES
1962		YES	YES	YES	YES
1963		YES	YES	YES	YES
1964		YES	YES	YES	YES
1965		YES	YES	NO	YES
1966		YES	NO	NO	YES
1967		YES	YES	YES	YES
1968		YES	YES	YES	YES
1969		*	*	*	*
1970		NO	NO	NO	NO
1971		YES	YES	YES	YES
1972		YES	YES	YES	YES
1973		YES	YES	YES	YES
1974		YES	YES	YES	YES
1975		NO	NO	NO	NO

Table 1. Punxsutawney Phil's Prediction Record, 1950-1999 (Continued)

Groundhog Day, Year	Did Phil See His Shadow?	Was Phil Correct?		
		Minimum Temperature	Maximum Temperature	Snowfall
1976	YES	YES	YES	YES
1977	YES	YES	YES	YES
1978	YES	YES	YES	YES
1979	YES	YES	YES	YES
1980	YES	YES	YES	YES
1981	YES	YES	YES	YES
1982	YES	YES	YES	YES
1983	NO	NO	NO	NO
1984	YES	NO	NO	NO
1985	YES	YES	YES	YES
1986	NO	NO	NO	NO
1987	YES	YES	YES	YES
1988	NO	NO	NO	NO
1989	YES	YES	YES	YES
1990	NO	NO	NO	NO
1991	YES	NO	NO	YES
1992	YES	YES	YES	YES
1993	YES	YES	YES	YES
1994	YES	YES	YES	YES
1995	NO	NO	NO	NO
1996	YES	YES	YES	YES
1997	NO	YES	NO	NO
1998	YES	YES	NO	YES
1999	NO	NO	NO	NO

^aMissing data values.

According to *The Old Farmer's Almanac 1998* [3, p. 67], "The chances that the groundhog's annual prediction will be accurate are exactly 50 percent." In *365 Days of Gardening* [1, p. 353], Allison writes: "The National Geographic Society reports that in a 60-year period, Brother Groundhog's ability to predict the spring season has registered at an unimpressive 28%." Our findings suggest that Phil's long-range weather prognostications are much better than some may think. Table 2 shows that Phil's temperature predictions (for both minimum and maximum) were 70.4 percent accurate and much more accurate when he did see his shadow than when he did not ($\%^2 = 51.598$, $p < .0001$). In fact, when Phil predicted an early spring (only ten times since 1950), he was rarely correct! Whenever he missed a minimum temperature prediction, he all but twice also missed that same year's maximum temperature prediction.

Table 2. Temperature Predictions (Minimum and Maximum Combined)

Was Phil Correct?	Did Phil See His Shadow?	
	YES	NO
YES	68	1
NO	10	19

With the exception of 1988 (when his view was no doubt obstructed by a “Bush”), Phil has seen his shadow in every presidential election year since 1952. But Phil’s shadow does not reveal a clear political bent. Over the last 50 years, when a Democrat has occupied the Oval Office on Groundhog Day, Phil’s minimum (maximum) temperature forecasts were 81.8 (68.2) percent accurate compared to 63.0 (70.4) percent accurate when a Republican resided in the White House.

Concluding Remarks

“Long before man invented the barometer,” says Bud Denkel, president of the Inner Circle, “groundhogs were predicting the weather.” Residents of Punxsutawney, in particular, proudly claim that their groundhog is never wrong. Almost. Based on local records of minimum and maximum daily temperatures since 1950, Punxsutawney Phil’s forecasts have been better than 70 percent accurate. But Phil isn’t the only groundhog in the weather-forecasting business. There’s Phil’s fellow Pennsylvanian Octorara Orphie. In Atlanta, a groundhog named General Beauregard Lee resides in a white-column miniature ante-bellum mansion on “Weathering Heights.” West Virginia is home to Concord Charlie and French Creek Freddie. Henrietta is the official Hoosier groundhog. And to Chicagoans, there’s Chipper, the Brookfield Zoo’s groundhog. Interested readers are invited to test their own furry weather forecaster’s predictions against those of the resident sage at Gobbler’s Knob in Punxsutawney, Pennsylvania.

References

1. Allison, C., *365 Days of Gardening*, HarperCollins, 1995.
2. Kroll, S., *It's Groundhog Day!* Scholastic, Inc., 1989.
3. Thomas, R. B., *The Old Farmer's Almanac 1998*, The Old Farmer's Almanac, 1997.

A Humanist's View

In *From Dawn to Decadence* (HarperCollins, 2000), Jacques Barzun says, on p. 189,

“Nor is there much gaiety in mathematics-geometry looks bare and algebra is one more step away from the familiar and friendly numbers.”